Group Formation of Automated Vehicles with Set-based Prediction

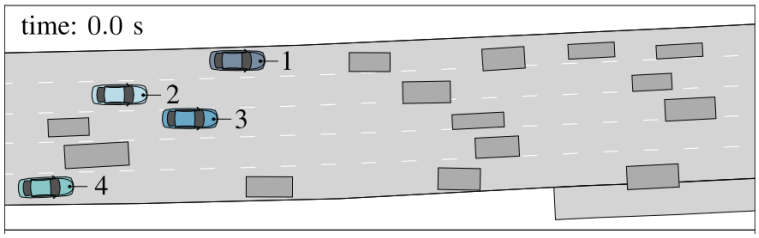
Technische Universität München

Fakultät für Informatik

Lehrstuhl für Robotik, Künstliche Intelligenz und Echtzeitsysteme

Background

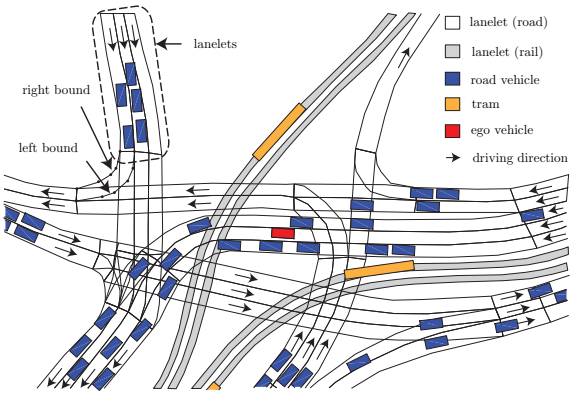
With increasing number of automated vehicles on roads, their cooperation will soon become important to fully unfold the anticipated advantages, which include reduction of the number of accidents, enhancement of traffic flow and passenger comfort, to name a few. One of the remarkable benefits of cooperative driving is that the vehicles can jointly plan maneuvers to prevent collisions that are otherwise inevitable. While an extensive amount of research have been devoted to the subject of cooperative/collaborative driving of automated vehicles, many works simply assume that the groups of cooperating vehicles are already given or known, which in fact requires further research and investigation.



A highway scenario where both human-driven and automated vehicles co-exist.

Description

The aim of this thesis is to answer the questions of When and How should vehicles form/deform cooperative groups? This can be done by combining a previous work [1] with set-based prediction of vechiles (see set-based prediction of vehicles [2]): if the predicted occupancies of two vehicles overlap at a near future time step, they are likely to be good candidates to form a cooperating group (and deform in the opposite situation). The results should be demonstrated with CommonRoad [3] scenarios, which is a benchmarks for motion planning on roads. An exemplary scenario in CommonRoad taken from the city center of Munich (Stachus) is shown below:



An exemplary scenario from Stachus in CommonRoad

Tasks

- Literature review of recent works related to group formation of vehicles/robots.
- Familiarizing with existing code.
- Familiarizing with CommonRoad and related software.
- Developing a universal group formation algorithms.

Supervisor:
Prof. Dr.-Ing. Matthias Althoff

Advisor:
Edmond Irani Liu, M.Sc.

Research project:
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Type:
Bachelor

Research area:
Cooperative Automated Vehicles, Reachability Analysis

Programming language:
Mainly Python, could involve some C++

Required skills:
Good programming skill and style, motivated, self-organized

Language:
English

Date of submission:
February 10, 2021

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- Testing & experimenting on different scenarios with varied parameters.
- Demonstration of results.
- Documentation of codes and other related materials.
- Writing thesis.

References

[1] C. Frese, J. Beyerer, and P. Zimmer, "Cooperation of cars and formation of cooperative groups," in *IEEE Intelligent Vehicles Symposium, Proceedings*, 2007, pp. 227–232.

[2] M. Koschi and M. Althoff, "Spot: A tool for set-based prediction of traffic participants," in *2017 IEEE Intelligent Vehicles Symposium (IV)*. IEEE, 2017, pp. 1686–1693.

[3] Commonroad. https://commonroad.in.tum.de/.

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